RUSKA MODEL 2456 LABORATORY ENVIRONMENT MONITOR USER'S MANUAL

2456

LABORATORY ENVIRONMENT MONITOR

(LEM)

USER'S MANUAL

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REVISION NOTICE

RELEASE NUMBER	REVISION	DATE OF REVISION	DESCRIPTION
2456-LEM-1D01	A	06/25/02	Original release.
2456-LEM-1D01	B	09/09/02	Changes per DC/RO-23500.
2456-LEM-1D01	C	11/11/02	Changes per DC/RO-23601.
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REVISION HISTORY

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Changes per DC/RO-23601

RELEASE 2456-LEM-1D01 **Revision D (11/18/03)**
Changes per DC/RO-24008

WARNING

PRESSURIZED VESSELS AND ASSOCIATED EQUIPMENT ARE POTENTIALLY DANGEROUS. THE APPARATUS DESCRIBED IN THIS MANUAL SHOULD BE OPERATED ONLY BY PERSONNEL TRAINED IN PROCEDURES THAT WILL ASSURE SAFETY TO THEMSELVES, TO OTHERS, AND TO THE EQUIPMENT.

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WHEN ANY MAINTENANCE IS PERFORMED, TURN OFF POWER AND REMOVE POWER CORD.

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SECTION 1.0
FUNCTION

1.1 GENERAL FUNCTION

The Ruska Laboratory Environment Monitor (LEM) monitors the fundamental environmental parameters; Temperature, Pressure, and Relative Humidity. The sensor data is collected, processed, and made available on the selectable, RS232 or RS485, communication port. The data logging functions allow for easy collection, verification of data integrity and use of historical data.

The LEM can be used as a stand alone device or in conjunction with other monitors. The monitor can also be used as the Air Density Monitor for the Ruska 2456 and 2465 models. If higher accuracy pressure data is needed, then a secondary RS232 communications port allows for use with Ruska 7220 / 6220 Portable Pressure Gauges and other pressure standards.

1.2 COMPONENTS

The LEM product comes with the following accessories:

1 - Power Plug (input: 110-240 Vac, 50/60Hz)	Ruska Part #62-315
1 - Communication Cable (F/F 9DSUB)	Ruska Part #8-823
1 - Software Packet	Ruska Part #2456-LEMCAL
1 - Manual	Ruska Part #LEM-1D01

1.3 PC REQUIREMENTS

Windows ™ 95, 98, 2000, or XP 130 MHz Pentium or higher

1.4 LEM BASICS

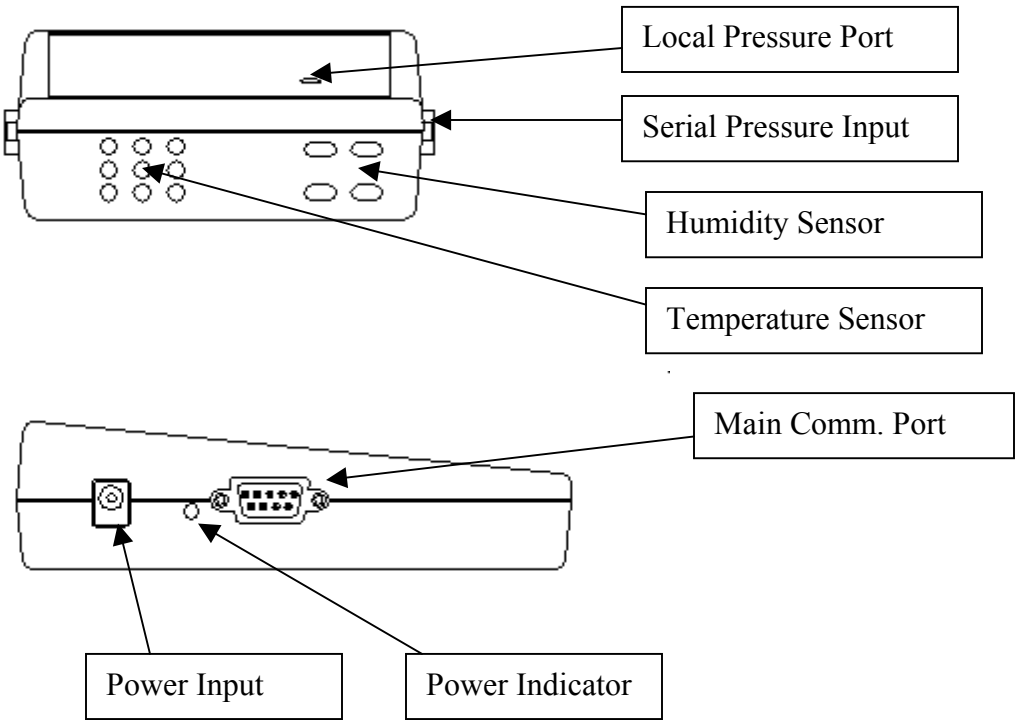

Figure 1-1
LEM General View

1.4.1 CALIBRATION DATA STORAGE

The calibration data is stored in the LEM. Refer to Section 5.0 for information on the Calibration process and how to access the coefficients.

1.4.2 MAIN COMM PORT

The main communication port is user selectable for RS232 or RS485, using a switch located on the bottom of the LEM (see Figure 1-2). Cycle the power to activate a change in the communication port.

The provided communication cable allows for the monitor to be directly connected to a standard PC - DB9 - RS232 port.

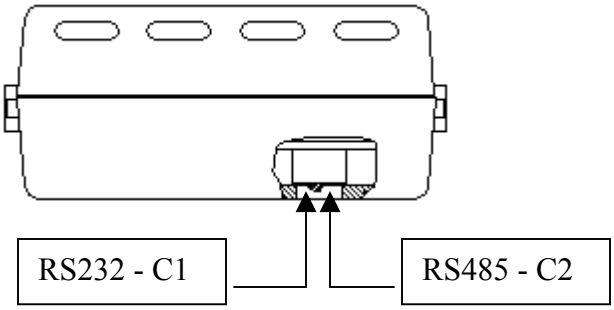

Figure 1-2
LEM Communication Switch

Optional USB cables are available: RIC# 8-825 - USB to RS232 (requires Windows 98 or higher).

1.4.3 POWER

The Power LED will illuminate when power is applied through either the power plug or the main communication port.

Refer to Section 6.0 - Connector Specification - for connector and pin out details.

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SECTION 2.0
GETTING STARTED

PC operation with Ruska LEMCal software and a single LEM

2.1 INTERCONNECT

The standard interface cable for the LEM is a DB9 F/F cable (Ruska part number: 8-823)

The green indicator light should come on when the power plug is connected.

2.2 SOFTWARE INSTALLATION

Step 1. Insert CD into drive.
The AutoRun function should begin the installation.

Step 2. If the AutoRun function does not begin then
Select Start and Select Run.
Type D:\Setup (where D is your CDROM directory)

Step 3. Double Click on the new LemCal icon in the Ruska Instrument Program group.

At this point, the System should display data. If not, or if customization is desired, then continue with Section 2.3.

2.3 SOFTWARE SETUP

2.3.1 HELP MENUS

The LEM software contains extensive help menus that provide detailed information about each function.

2.3.2 SERIAL PORT SETUP

From the menu select **Setup|Communication**

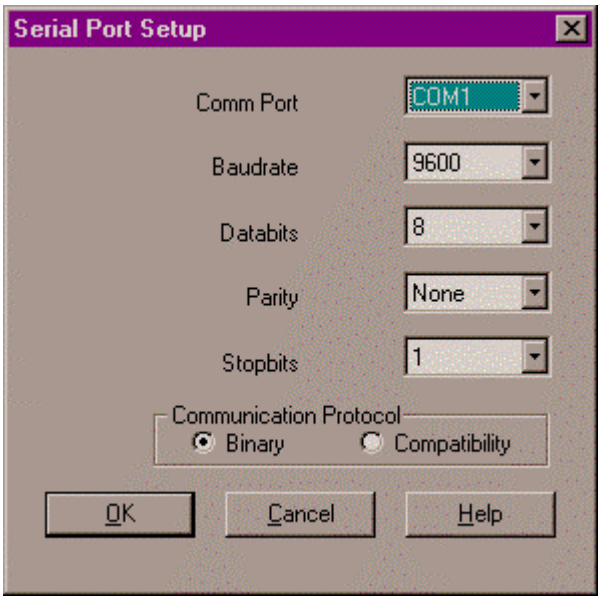

FIGURE 2-1
SERIAL PORT SETUP

The default settings are shown. Change the Comm Port to match the host computer. The Baudrate, Databits, Parity and Stopbit defaults should be set as shown in Figure 2-1.

2.3.2.1 Communications Protocol

See Section 9.2 Remote Commands for a description of the Communication Protocol.

2.3.3 LEM ADDRESSING

From the menu select **Setup|Options**

2.3.3.1 LEM

The factory default address is **33**.

This address can be changed to any address between 0 and 99.

The 0 address is the global address. When a command is issued with the 0 address all instruments on the communication bus will respond.

To view the address and Calibration Coefficients go to **Calibrate|View Coefficients** (Figure 2-2).

To change the address, double click on the Address Window, answer "Yes" to editing coefficients, and enter a new address. Click on the "Write Coefficients to Sensor" icon to write the coefficients to the LEM. This will take several seconds.

This function can be password protected. Refer to Section 2.3.7.

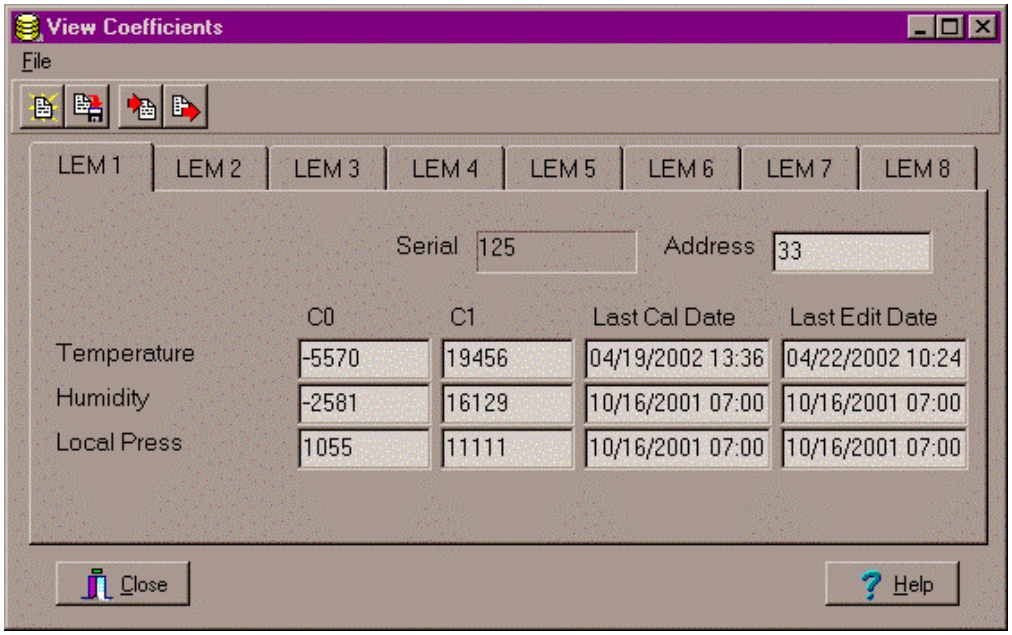

FIGURE 2-2
VIEW COEFFICIENTS

2.3.3.2 LEMCAL Software

The factory default address is 33. The LEM and LEMCAL Software default to this Address. The LEMCAL Software needs the address set in the SETUP/OPTIONS screen of the LEM with which it will communicate. If this address is set to 0 then all LEMs on the communication bus will respond.

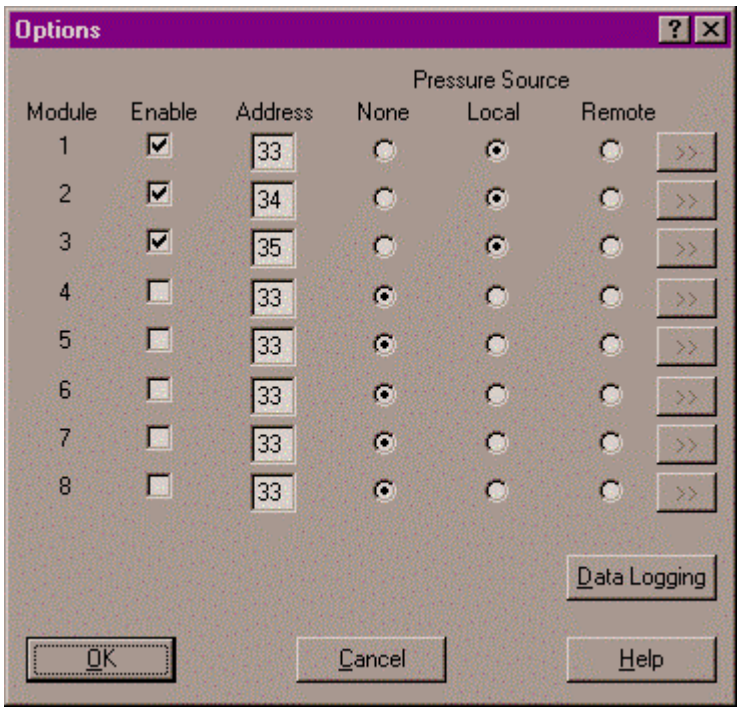

FIGURE 2-3
OPTIONS

2.3.4 SELECTING A PRESSURE SOURCE

From the Menu select **Setup|Options**

Select the Local or Remote pressure sources for each enabled LEM by clicking on the appropriate column. The Local sensor location is shown in Figure 1-1 and specified in Section 8.0. Refer to Section 4.0 for description of the Remote Pressure function.

2.3.5 SELECTING UNITS

From the Menu select **Setup|Units**.

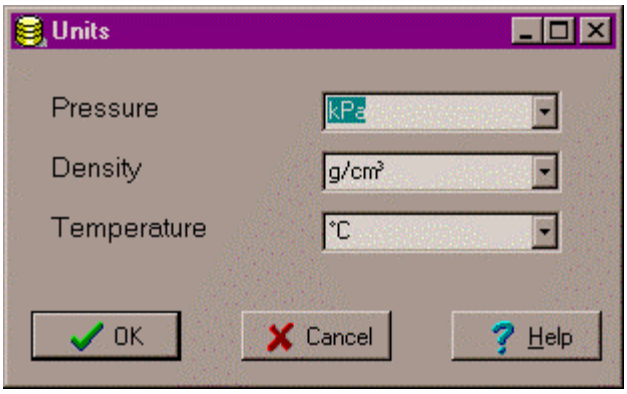

FIGURE 2-4
UNITS

Select desired units from the available choices for each environmental parameter. Changing units will also change the data written to the logfile. Refer to Section 2.5.

2.3.6 LIMITS

From the Menu select **Setup|Limits**.

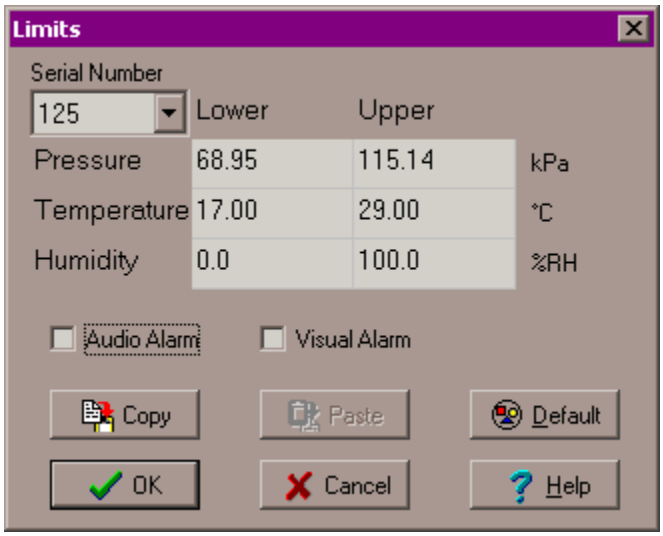

FIGURE 2-5
LIMITS

Select values for the upper and lower limits for Pressure, Temperature, and Relative Humidity.

2.3.6.1 Setup

The Serial Number for the desired LEM is selected in the box in the top, left corner. Click the arrow, and the available LEMs will be displayed. When a specific instrument is selected, the current limits are displayed, and may be edited.

The Audio Alarm is enabled by checking the Audio Alarm checkbox. This alarm generates a standard beep using the computer speaker.

The Visual Alarm is enabled by checking the Visual Alarm checkbox. This alarm is displayed on the main screen by changing the background color of the Serial Number to yellow whenever a limit is exceeded. The background will remain yellow until it is either disabled, or reset. Double-clicking the Serial Number will reset the visual alarm, but does not disable it.

The Audio and Visual alarms can be set by double-clicking the message panel at the lower-left corner of the main screen, until the desired setting is selected.

The limit values for one instrument may be copied to another instrument's limit values, by using the Copy and Paste buttons. Closing the Limit form will erase values from the copy buffer.

Pressing OK will check the new values for out-of-range and inconsistent values. If a problem is detected, an error message is displayed.

Pressing CANCEL will leave the Limits unchanged.

Pressing DEFAULT will return all limits, for the selected instrument, back to default values.

2.3.6.2 Error Limit Logging

Crossing a limit value, will trigger a record being entered in the log file, if enabled. Refer to Section 2.5.

2.3.7 PASSWORD PROTECTION

Two types of password protection are supported – Calibration and Program Exit.

2.3.7.1 Calibration Password

From the Menu select **Setup|Password|LEM**

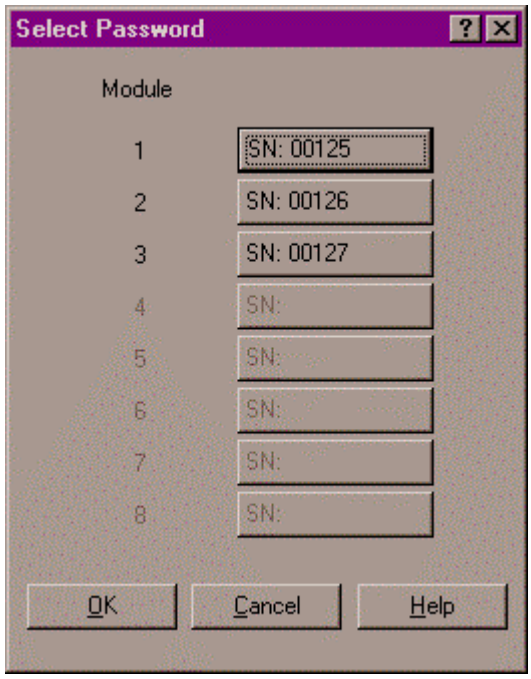

FIGURE 2-6
SELECT PASSWORD

This password protection will prevent the changing of the calibration data and address. The default password is "**0**" (zero). When the password is "**0**" the password protection is turned off.

When setting the password for the first time, "**0**" must be entered as the Old Password.

The password can be reset to "**0**" as long as the current password is known.

The password can be up to eight alpha/numeric characters long and is case sensitive.

2.3.7.2 Program Exit Password

From the Menu select **Setup|Password|Program Exit**

FIGURE 2-7
CHANGE EXIT PASSWORD

This password protection will prevent closing LEMCal software. This is most useful when the Logfile function is being used, and a record without gaps is desired. The default password is "**0**" (zero). When the password is "**0**" the password protection is turned off.

When setting the password for the first time, "**0**" must be entered as the Old Password.

The password can be reset to "**0**" as long as the current password is known.

The password can be up to eight alpha/numeric characters long and is case sensitive.

2.4 VIEWING REAL TIME DATA

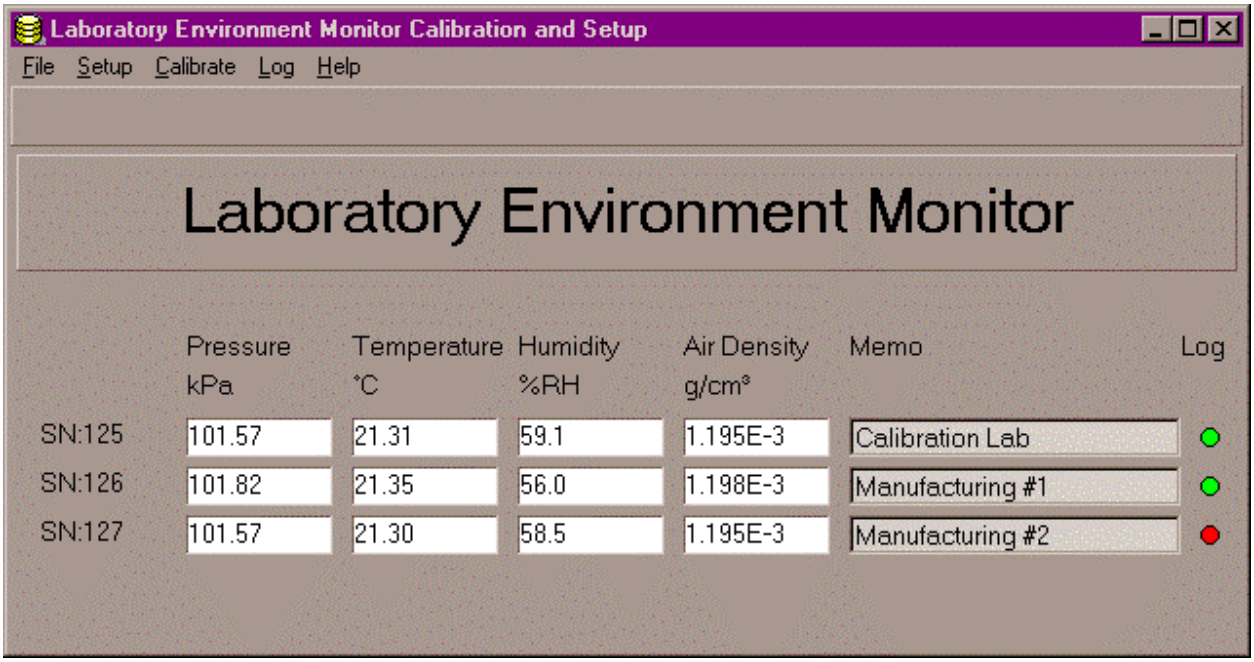

FIGURE 2-8
MAIN SCREEN

The Memo line allows a user to enter a descriptive to identify each LEM. This description is associated with the Serial Number and is stored in the *.ini file on the host computer.

The green indicator at the end of each line identifies if the LEM data is being logged. See Section 2.5 for Data Logging

*** If the Data Line turns **YELLOW** then the data being displayed is out of the following ranges: 17°C < temperature <29°C
0% < relative humidity < 100%
10 psi < pressure < 16.7 psi

*** If the Data Line turns **RED** then communication has been lost with the LEM.

2.5 LOGGING DATA

The Data Logging function captures Temperature, Pressure, Relative Humidity and Air Density (Section 7.1 - NBS Pub. 700-1)

2.5.1 SETUP

From the Menu select Log (Figure 2-8).

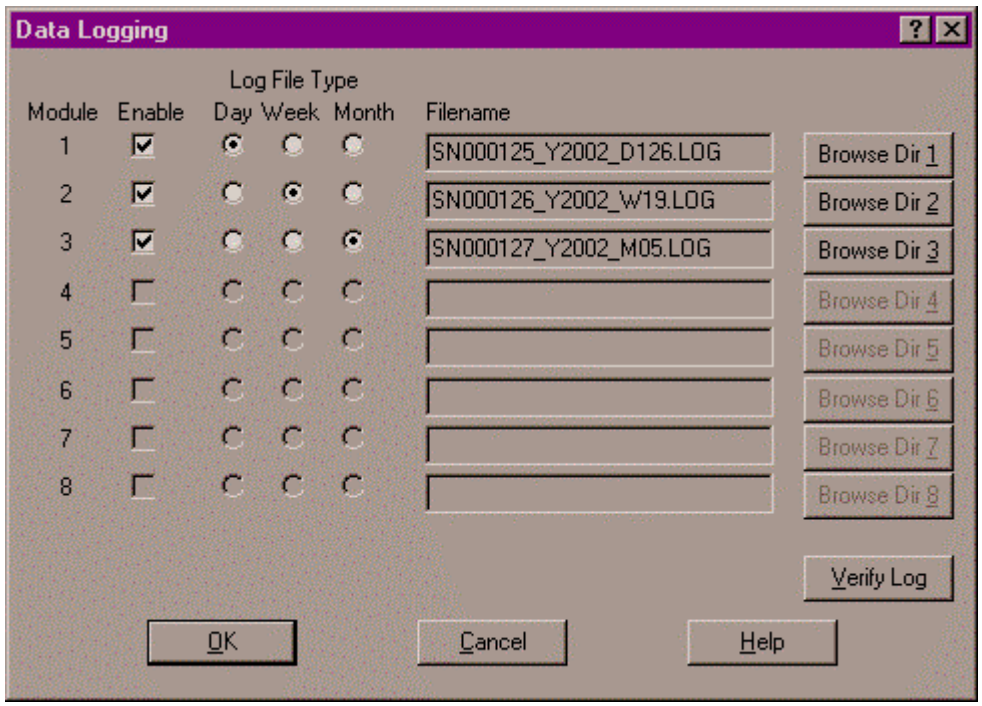

FIGURE 2-9
DATA LOGGING

The Module number, in the left hand column, is referenced to each LEM as defined in Figure 2-3 and Figure 2-6. To begin logging data for a particular LEM, select the Enable button.

2.5.2 INTERVALS

LEM data can be logged into a Day, Week, or Monthly file.

Timing and date information are based upon the clock of the host computer.

Day: Readings are taken at 1 minute intervals.
The active file is saved and a new file is created at midnight of each day.

Weekly: Readings are taken at 5 minute intervals.
The active file is saved and a new file is created at midnight of each Saturday.

Monthly: Readings are taken at 15 minute intervals.
The active file is saved and a new file is created at midnight of the last day of each month.

2.5.3 FILE NAMES

The file names are generated automatically using the following formats -

Day: *SerialNumber_Year_Day of Year.LOG*
Example: SN054323_Y2002_D137.LOG

Week: *SerialNumber_Year_Week of Year.LOG*
Example: SN054323_Y2002_W47.LOG

Month: *SerialNumber_Year_Month of Year.LOG*
Example: SN054323_Y2002_M05.LOG

2.5.3.1 Default Location

By default, the log files are placed in

C:\ Program Files \ Ruska Instrument \ LEM Cal \ LEMDataLog \.

To change this location, select <Browse Dir> button - Figure 2-9.

2.5.4 FILE VERIFICATION

From the Data Logging screen (Figure 2-9) select - Verify Log.

Select the *.LOG file that needs to be verified. Upon completion of the verification a notice of verification will be displayed or a file *.ERR will be created and saved in the LOG directory. This file will identify which lines of the *.LOG file have been corrupted or altered. If any errors are detected then the corrupted lines are stored in a *.ERR file.

2.6 MULTIPLE LEMS

The LemCal software supports up to 8 LEM modules at the same time when using RS485. Refer to selection 1.4.2 for selecting RS485 mode.

2.6.1 CABLING

For MULTI-DROP SYSTEMS refer to Section 9.4 for available components. For custom cabling, refer to Section 6.2 for the pinout of the Main Communication Port on the LEM.

2.6.2 ADDRESSING

Since the default address for each module is "33", each module will need to have its address set to a unique number between 0 and 100. This must be done with only one non-unique module on the communication bus at a time. Refer to Section 2.3.3. Each LEM must have a unique address and LEMCAL Software must be told which addresses are active on the communication bus.

SECTION 3.0
RUSKA 2456 & 2465 OPERATION WITH THE LEM

3.1 COMMUNICATIONS

Set the communications interface to RS485 for use with the 2456 and 2465. Refer to Section 1.4.2 for LEM communication setup. Power for the LEM is supplied from the 2456 or 2465, over the communications cable. Use a standard DB9M / DB9F cable (Ruska PN: 8-826).

3.2 WINPROMPT INTERFACE

Refer to the WinPrompt manual for detailed instructions. WinPrompt Version 2.12 or later is required. WinPrompt software calculates mass to pressure and pressure to mass values, and automatically displays real time piston gauge parameters measured by the Model 2456 Deadweight Gauge Monitor or the Model 2465 AutoFloat Controller.

3.3 MODEL 2456 AND MODEL 2465 UPGRADE FOR LEM COMPATIBILITY

To upgrade a 2456/2465 from the original Air Density Model to the LEM, use Ruska part number 2465-200-KIT1 for all 2465's and the Single Channel 2456. Use Ruska part number 2465-200-KIT2 for the Dual Channel 2456.

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SECTION 4.0
REMOTE PRESSURE CAPTURE

From the Menu select **Setup|Options** (refer to Figure 4-1). Set the Pressure Source as Remote. Click the extension arrows to the right of the selected LEM. The Remote String Dialog box will appear.

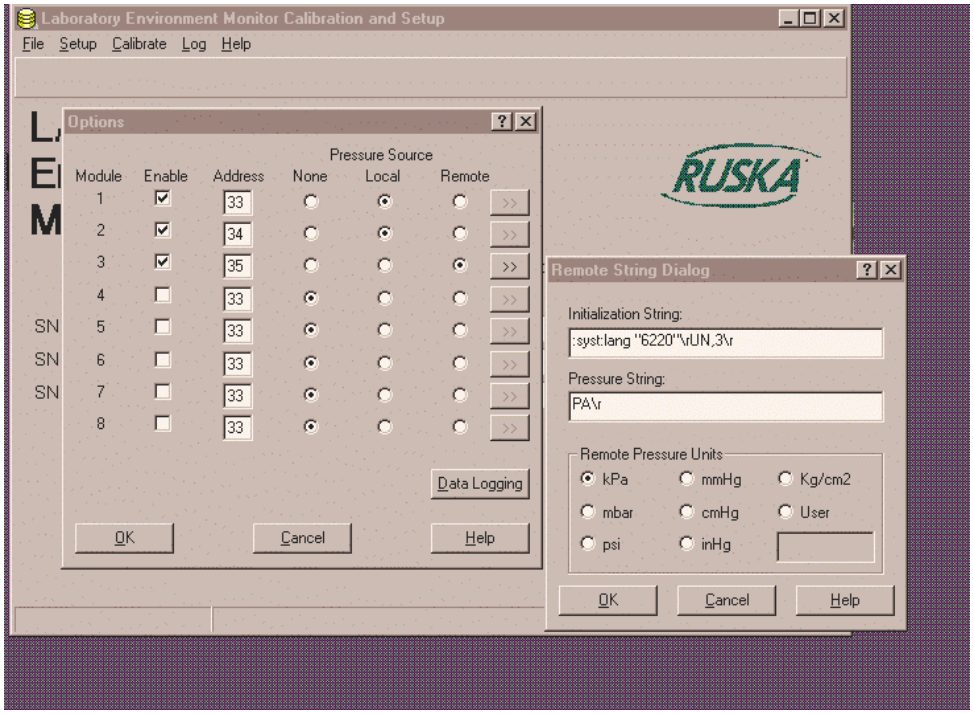

FIGURE 4-1
REMOTE STRING SELECTION

4.1 USE WITH A RUSKA PORTABLE PRESSURE GAUGE 7220 OR 6220.

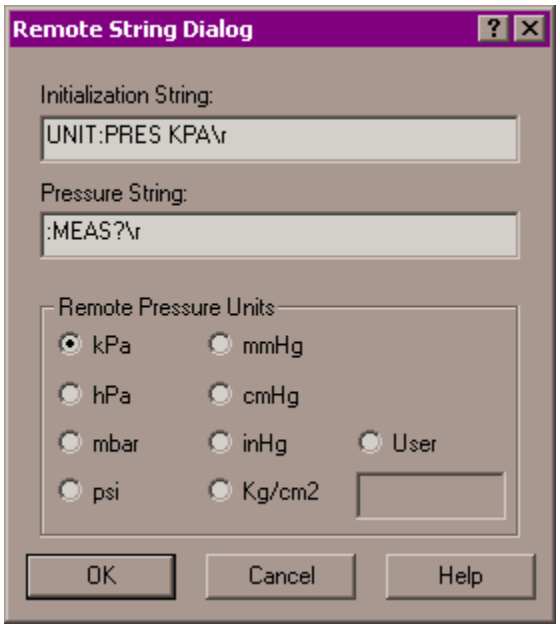

FIGURE 4-2
REMOTE STRING DIALOG

Initialization String Transmitted from LEM to remote pressure sensor to initialize the remote sensor.

Pressure String Transmitted from LEM, on a continuous basis, to retrieve pressure readings.

Remote Pressure Units Specifies the units that are being returned from the remote pressure sensor. The selection of the User units requires the entry of a conversion factor. The User units multiplied by the conversion factor results in kPa. (Refer to Section 9.3 for conversion factors.)

4.2 INITIALIZATION STRING

4.2.1 RUSKA MODEL NUMBER 6220
'UN,3\r' - This sets the units to kPa.

4.2.2 RUSKA MODEL NUMBER 7220 USING SCPI PROTOCOL
'UNIT:PRES KPA\r'
This sets the 7220 to kPa units.

4.2.3 RUSKA MODEL NUMBER 7220 USING 6220 EMULATION MODE
':SYST:LANG "6220"\rUN,3\r'
This sets the 7220 to 6220 emulation mode and to kPa units.

Refer to the 6220 and 7220 manuals for other options.

4.3 PRESSURE STRING

4.3.1 6220 AND 7220 IN EMULATION MODE.
The pressure command string is 'PA\r'.

4.3.2 7220 IN SCPI MODE.
The pressure command string is ':MEAS?'.

4.4 CABLING

4.4.1 RUSKA MODEL 6220 TO THE LEM PRESSURE SERIAL PORT
25 pin RS-232-C connector of the 6220

PIN	DESCRIPTION
2	Transmitted data (to PPG)
3	Receive Data (from PPG)
4*	RTS (must be set for PPG to transmit)
5*	CTS (always set by PPG)
7	GND

*Connect Pins 4 & 5 together.

6220 DB25	LEM DB9
2	3
3	2
7	5

Refer to 6220 Manual and Section 6.2 of this manual for additional information.

4.4.2 RUSKA MODEL 7220 TO THE LEM PRESSURE SERIAL PORT
Requires a Null modem adapter or Null modem cable DB9 M / DB 9 F. Only Pins 2 and 3 must be swapped in the Null Modem cable.

4.5 USE WITH OTHER RS232 OUTPUT TRANSDUCERS

4.5.1 PROTOCOL
The LEM can retrieve pressure data from other "smart" pressure sensors, as long as the return string can be parsed. The string returned to the LEM must be in ASCII characters.

The LEM breaks down the returned string as follows:

1. Delete Prefix - all non-numeric characters are deleted up to the first numeric character.

2. The Exponent character (E or e) is located.
3. A one or two digit numeric exponent is read following the Exponent character.

   Examples of valid returned strings:

   101.23
   101.23kPa
   1.0123E02
   PA, 1.0123e02 kPa
   PA, 101.23

4.5.2 SCALING

Once the raw value is retrieved from the string then units or a scaling factor must be given. Refer to Section 4.1 "Remote Pressure Units".

4.5.3 COMMUNICATION PORT CONFIGURATION

This configuration applies only to the Remote pressure Input and is set as follows:

BAUD RATE	-	2400
DATABITS	-	8
PARITY	-	None
STOPBITS	-	1

SECTION 5.0
CALIBRATION

5.1 SPAN

5.1.1 PRESSURE - ON BOARD SENSOR
Calibration Point 1: 10.5 +/-0.25 psia
Calibration Point 2: 15.0 +/-0.25 psia

5.1.2 TEMPERATURE
Calibration Point 1: 17 +/- 2 degC
Calibration Point 2: 29 +/- 2 degC

5.1.2.1 Zeroing

Temperature measuring devices are impacted by self heating. The rise in temperature, measured by the sensor, is a function of the amount of heat generated by the probe and the ability of the probe to dissipate this heat. Air flow around the probe improves the heat dissipation and thus lowers the rise in temperature. When a temperature probe is calibrated in a high flow chamber and used in a low flow environment, then the error due to self heating is maximized. This error can be minimized by zeroing the sensor in the operating environment with respect to an appropriate standard.

The LEM software allows the technician to perform a zero offset. The zero offset is prompted following the span calibration. After the span calibration is finished, the high air flow chamber can be turned off and the LEM can be zeroed in a low air flow environment that is typical of its operating environment.

The reference probe should be placed at a distance of 3 or more inches in front of the LEM temperature sensor.

Both the span calibration and zeroing operation are password protected.

5.1.3 HUMIDITY

The humidity calibration must be done after the Temperature calibration. The two calibration points must be different by at least 25%RH.
A suggested method:

Point 1: applied vacuum -> 0%RH
Point 2: ambient humidity (25%RH or higher)

5.2 CALIBRATION DATA

In order to view the calibration coefficients, select **Calibrate|View Coefficients**.

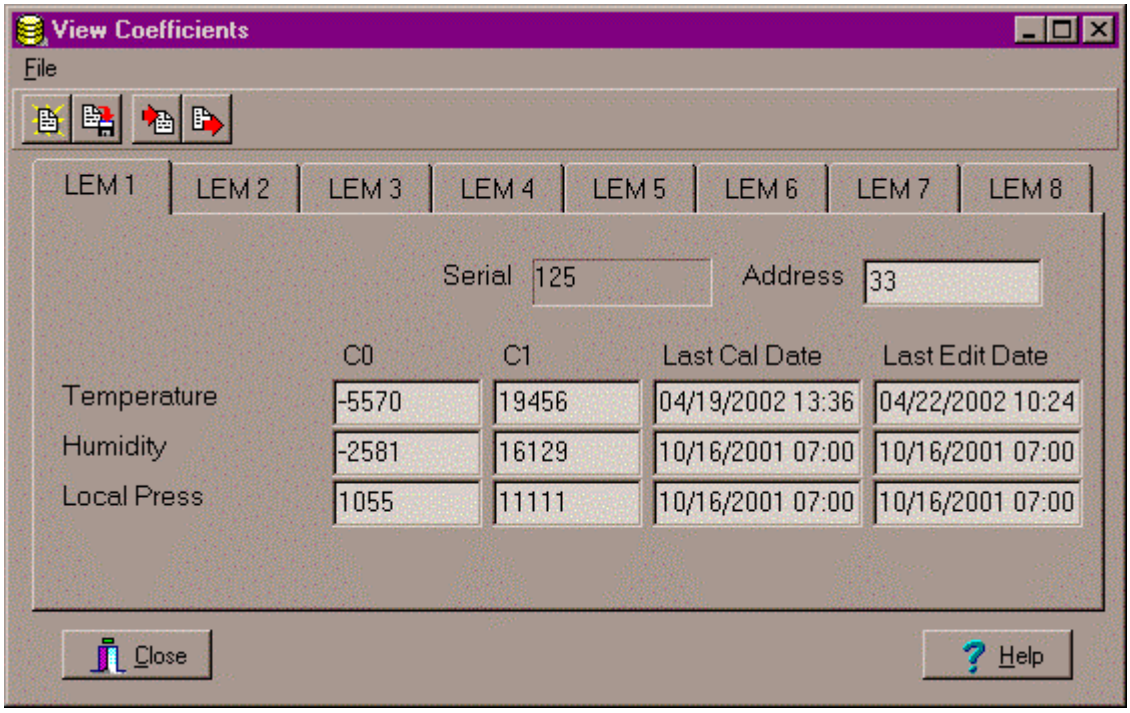

FIGURE 5-1
VIEW COEFFICIENTS

The menu bar selections allow the coefficients to be read and written to disk and read and written to the LEM, assuming that the proper password is known.

SECTION 6.0
CONNECTOR DEFINITION

6.1 POWER PLUG

The power plug is a barrel type receptacle:

ID = 2.5 mm, OD = 5.5 mm, Depth = 10.0 mm, Inside - Positive

6.2 DB9 CONNECTORS

TABLE 6-1
DB9 PINOUT

Pin #s DB9	DB9 male RS 485	DB9 male RS 232	DB9 female (RS 232)
1*	+PWR IN	+PWR IN	NC
2**	A	TX	RX
3**	A	RX	TX
4	GND-PWR	GND-PWR	GND
5	GND-SIG	GND-SIG	GND
6	NC	NC	NC
7	NC	NC	NC
8**	B	RX	NC
9	GND-PWR	GND-PWR	GND

*Supply pin (PIN 1 DB9 female) is fused with re-settable fuses. Maximum operating current is 50 mA.

** Pin 3 of the primary connector (DB9 male) is switched between Pins 2 and 8. This allows compliance with Ruska ER-3097 : "DB9-232/485-Pin Out Standard".

6.2.1 PRESSURE PORT

The pressure port is a friction fit - press on tube connection.

Motorola® package definition CASE 482A-01

Use Ruska tubing RIC# 86-1011 - 3mm ID tubing or equivalent.

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SECTION 7.0
AIR DENSITY CALCULATION

7.1 LEM INTERNAL CALCULATION VS. RUSKA PC SOFTWARE CALCULATION

The Air Density calculation available directly from the LEM is a best fit curve approximation as described in Section 7.1.1.

The Air Density output available from Ruska PC Software (WinPrompt, LEM PC, etc.) uses the definition available per National Bureau of Standards, NBS Special Publication 700-1, Industrial Measurement Series (November 1984).

7.1.1 AIR DENSITY AVAILABLE DIRECTLY FROM LEM (without LEMCAL or WinPrompt Software).

T = Temperature (16-bit integer, scaled °C*100)
H = True RH (16-bit integer, scaled %*100)
P = Pressure (16-bit integer, scaled kPa*100)
D = Density (16-bit integer, g/m^3)

$$D = \frac{\left(P*4916 - \left(\frac{T*2096}{2^{16}} - 20 \right)^{*} H \right) * \frac{46460}{2^{16}}}{T + 273.15}$$

NOTE: Formula is valid for temperatures 18-28°C.

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SECTION 8.0
SPECIFICATIONS

8.1 SENSORS:

Operating Range:

Temperature:	18-28°C
Pressure:	690-1070 mbar (20.4 - 31.6 inHg)
Humidity:	5-95% RH

Performance:

Precision

Temperature:	+/-0.1°C
Pressure:	+/-1.4 mbar (+/-0.04 inHg)
Humidity:	+/-3% RH

Total Uncertainty:

Temperature:	+/-0.5°C/year
Pressure:	+/-2.7 mbar (+/-0.08 inHg)/year
Humidity:	+/-10% RH/year

Notes:

(1) Precision is defined as the combined effects of linearity, repeatability and hysteresis.

(2) Expression of accuracy (uncertainty) conforms with the recommendation of the ISO Guide to the Expression of Uncertainty in Measurement and includes RSS of precision, stability, temperature effects, and the calibration standard to 2 sigma (95%). The expanded uncertainty in the standards utilized by Ruska to calibrate the LEM is typically 0.1°C, 2.4% RH, 1.4e-3 kPa.

Storage Environment: -20 - 70 °C; 0 - 95% relative humidity, non-condensing

Electrical Power: 10 - 30 Volt DC input; 250mA max

Data Update Rate: New Data available at 1 second intervals. Includes Temperature, Humidity, Pressure, Air Density.

Available Units:

from Module :	°C x100, %RH x100, kPa x100, g/m^3
from *.dll:	°C, %RH, kPa, g/m^3
from PC Software :	°C, °F; %RH; mmHg, cmHg, inHg, kPa, hPa, mbar, psi, kg/cm^2; g/cm^3, kg/m^3, lb/in^3

Warm up:

Typically 30 minutes.

Placement:

The proper orientations for the LEM are

1) Set flat on the table, sitting upon the rubber feet
2) Hanging on the wall with the temperature sensor pointing down.

Calibration period:

1 year

SECTION 9.0
APPENDIX

9.1 OPENING THE ENCLOSURE

Unplug power and communication cables.

Remove the pressed in rubber feet.

Remove the four screws.

The top cover should come off easily.

When installing the cover do NOT over tighten the screws. Tighten the screws just until the top and bottom covers meet.

9.2 REMOTE COMMANDS

There are two general standards supported.

The Binary protocol requires fewer bytes, therefore requiring less time to transmit each message.

The Compatibility protocol requires more bytes per message, but allows the module to co-exist on the same RS485 bus with other DruckBus compatible components.

DruckBus Binary Standard

Command:

<Addr><Size><Cmd>[<Parm1>[<Parm2>...]]<Chk>

Reply:

%<Addr><Size><Cmd><Parm1>[<Parm2>...]<Chk>

Example: (hexadecimal bytes)

26 01 01 56 70
25 01 05 76 02 03 04 CB 99

DruckBus Compatibility Standard

Command:

$<Addr><Size><Cmd>[<Parm1>[<Parm2>...]]<Chk>CR

Reply:

!<Addr><Size><Cmd><Parm1>[<Parm2>...]<Chk>CR

Example:

$01015670cr
!010576020304CB99cr

Terminology:

<Addr>	Ascii	2 characters specifying the address (00 to 99, 00=Global). Replies always specify the address of the unit, never 00.
	Binary	1 byte specifying the destination address of the command or the source address of the reply (00 to FF, 00=Global). Replies always specify the address of the unit, never 00.
<Size>	Binary	Number of bytes after the size byte not including the <Chk>
<Cmd>	Ascii	2 Ascii characters specifying command.
	Binary	1 Ascii byte specifying command (Uppercase on command, lowercase on reply).
<Parm x>	Ascii	Variable-length Ascii formatted parameters.
	Binary	Fixed-length binary parameter.
<Chk>	Binary	1 binary byte LRC (exclusive-or of all bytes including start)
CR	Ascii	Carriage Return required
	Compatibility	Carriage Return required
<start>	Start	Binary mode Command = '&' ; Reply = '%' Compatibility mode Command = '$' ; Reply = '!'

TIMING

Slaves must wait at least 1 character time before replying (for RS-485 line turnaround) and must reply within 50 ms.

GLOBAL COMMAND RESPONSES

Units respond to Zero, the global address, the same as their assigned address. This means that global addressing can be used when only 1 unit is on the bus.

DruckBus Binary Mode Commands

(Commands may be translated to Compatibility Mode for transmission)

@ - Set Address

Command: <start><addr><Size>@<NewAddr><Model><Value><Chk>
Reply: None.

Command <Size>: 8
<NewAddr> is an 8-bit unsigned number. <Model> is a 2-byte integer containing the model number, least significant byte first. <Value> is a 4-byte integer specifying a pressure in kPa * 100 or a serial number, least significant byte first. Normally, this command is sent using the global address. This command sets the address of the unit to the specified address with the following conditions:

1. If the model number and value are both zero, all units receiving this command will set their address.
2. If the model number in the command is not zero and the model number of the unit matches the specified model, the address is set.
3. If the model number matches and if the pressure specified in the command is not zero and the full scale pressure of the unit is greater than, or equal to, the specified pressure and the current address of the unit is 254 or 255, the address is set.
4. If the model number is zero, and a non-zero value is specified, and the value matches the serial number of the unit, the address is set.

These conditions allow for the addresses of each different model to be set individually and the units of the same model to be set by pressure range. If two units have the same model and pressure range the address can still be set by serial number.

A – Read ADC Counts

Command: <start><addr><Size>A<chk>
Reply: <start><addr><Size>a<status><temp><rh><pressure><chk>

Command <Size>: 1
Reply <Size>: 10
<status> is three unsigned 8-bit values.
Status1:

Bit 0: ADC channel 0 Extended Input Range Indicator (EXR0)
0: $0 < V_{in} <= V_{ref}$
1: $V_{in} > V_{ref}$ or $V_{in} < 0$
Bit 1: ADC channel 0 Sign Indicator (SIG0)
0: $V_{in} < 0$
1: $V_{in} > 0$
Bit 2: ADC channel 1 Extended Input Range Indicator (EXR1)
Bit 3: ADC channel 1 Sign Indicator (SIG1)
Bit 4: ADC channel 2 Extended Input Range Indicator (EXR2)

Bit 5: ADC channel 2 Sign Indicator (SIG2)
Bit 6: ADC channel 3 Extended Input Range Indicator (EXR3)
Bit 7: ADC channel 3 Sign Indicator (SIG3)

Status2:
Bit 0: 1 = Calibration in Progress

Bit 1: 1 = Zero in Progress
Bit 2: 1 = Remote Port Selected (v1.4)
Bit 3-7: Reserved

Status3:
Bit 0: 1 = Command Error
Bit 1: 1 = EEPROM Write Error
Bit 2: 1 = EEPROM Read Error
Bit 3: 1 = Power-on Reset
Bit 4: 1 = RS232 Receive Error
Bit 5: 1 = Calibration Error
Bit 6: Reserved
Bit 7: 1 = Long (multiple) EEPROM accesses

<temp> is a 16-bit unsigned value
<rh> is a 16-bit unsigned value
<pressure> is a 16-bit unsigned value

C – Configure Instrument

Command: <start><addr><Size>C<cfgByte><chk>
Reply: <start><addr><Size>c<cfgByte><chk>

Command <Size>: 2
Reply <Size>: 2
Defines which pressure source to use. <cfgByte> is an 8-bit unsigned value.
<cfgByte>
= 0 No pressure source selected
= 1 Local pressure
= 2 Auxiliary pressure
= 3 Remote pressure
= 254 Load LEM Memory from eeprom
= 255 Poll for currently selected pressure source

D – Read Air Density

Command: <start><addr><Size>D<chk>
Reply: <start><addr><Size>d<status><density><chk>

Command <Size>: 1
Reply <Size>: 6
<status> is three unsigned 8-bit values. (See Command A)
Returned data is a 16-bit unsigned value, least significant byte first.

E – Read EEPROM

Command: <start><addr><Size>E<addr1><chk>
Reply: <start><addr><Size>e<data><chk>

Command <Size>: 3
Reply <Size>: 9
<addr1> is 16-bit address, least significant byte first.<data> is 8 bytes read from EEPROM.
To read the eeprom, set the high byte of <addr> to 00H
To read low memory, set the high byte of <addr> to F0H
To read extended memory, set the high byte of <addr> to F1H.
Address should be an 8-byte boundary.

K - Calibrate

Command: <start><addr><Size>K<channel><point><value><chk>
Reply: <start><addr><Size>k<status><counts><chk>

Command <Size>: 5
Reply <Size>: 6
<channel> and <point> are 8-bit values.
<channel> selects channel to be calibrated. P for pressure, H for humidity, T for temperature.
<point> is 1 for first point, 2 for second point.
<value> is a 16-bit signed integer using scaled (*100) units matching select channel.
<status> is three unsigned 8-bit values. (See Command A)
<counts> is an unsigned 16-bit value.

P – Set Initialization and Remote Pressure Strings

Command: <start><addr><Size>P<seq><strlen><strseq><chk>
Reply: <start><addr><Size>p<status><chk>

Command <Size>: 11
Reply <Size>: 4
<seq> identifies which 8 byte substring is being transmitted. Acceptable Values for the Remote String are 0, 1, 2. Acceptable Values for the Initialization String: 3, 4, 5.

<strlen> is the actual length of the command string, in bytes, that will be transmitted from the LEM to the remote pressure sensor over the software serial port. Acceptable values: 1-24.

<strseq> is an 8 byte section of the string to be transmitted. The string to be transmitted must be 24 characters long, using a pad character to fill out the string. The first eight bytes are transmitted with <seq> set to 0 for the Remote Pressure string and 3 for the Initialization string, the middle eight bytes are transmitted with <seq> set to 1 for the Remote Pressure string and 4 for the Initialization string, and the last eight bytes are transmitted with <seq> set to 2 for the Remote Pressure string and 5 for the Initialization string. All three <seq> substrings for each string must be transmitted in sequential order. Either string may be updated without updating the other.

<status> is three unsigned 8-bit values. (See Command A)

R - Read ADC Reference Values

Command: <start><addr><Size>R<chk>
Reply: <start><addr><Size>r<temp><rh><press><chk>

Command <Size>: 1
Reply <Size>: 7
All values are 16-bit signed integers using scaled (*100) units.
<temp> is degrees C
<rh> is %
<press> is kPa.

S - Read Remote Pressure with Displayed Precision

Command: <start><addr><Size>S<chk>
Reply: <start><addr><Size>s<status><press><decimals><chk>

Command <Size>: 1
Reply <Size>: 9
<status> is three unsigned 8-bit values. (See Command A)
<press> is 32-bit unsigned integer using scaled (*10^decimals) units. Units is kPa.
<decimals> is 8-bit signed integer

V - Get Version Info

Command: <start><addr><Size>V<chk>
Reply: <start><addr><Size>v<versionmajor><versionminor><HWVer>
<SubModel><model><chk>

Command <Size>: 1
Reply <Size>: 7
<versionmajor> is an unsigned 8-bit unsigned value
<versionminor> is an unsigned 8-bit unsigned value
<HWVer> is an unsigned 8-bit unsigned value
<SubModel> is an unsigned 8-bit unsigned value
<model> is a 2-byte flag used to differentiate between software with different command sets.

W - Write EEPROM

Command: <start><addr><Size>W<addr1><data><chk>
Reply: <start><addr><Size>w<data><chk>

Command <Size>: 11
Reply <Size>: 9
<addr1> is a 16-bit address, least significant byte first.
<data> is 8 bytes read from EEPROM.

To write the eeprom, set the high byte of <addr> to 00H.
To write low memory, set the high byte of <addr> to F0H.
To write extended memory, set the high byte of <addr> to F1H.

Address should be an 8-byte boundary.

Z - Zero

Command: <start><addr><Size>Z<channel><value><chk>
Reply: <start><addr><Size>z<status><counts><chk>

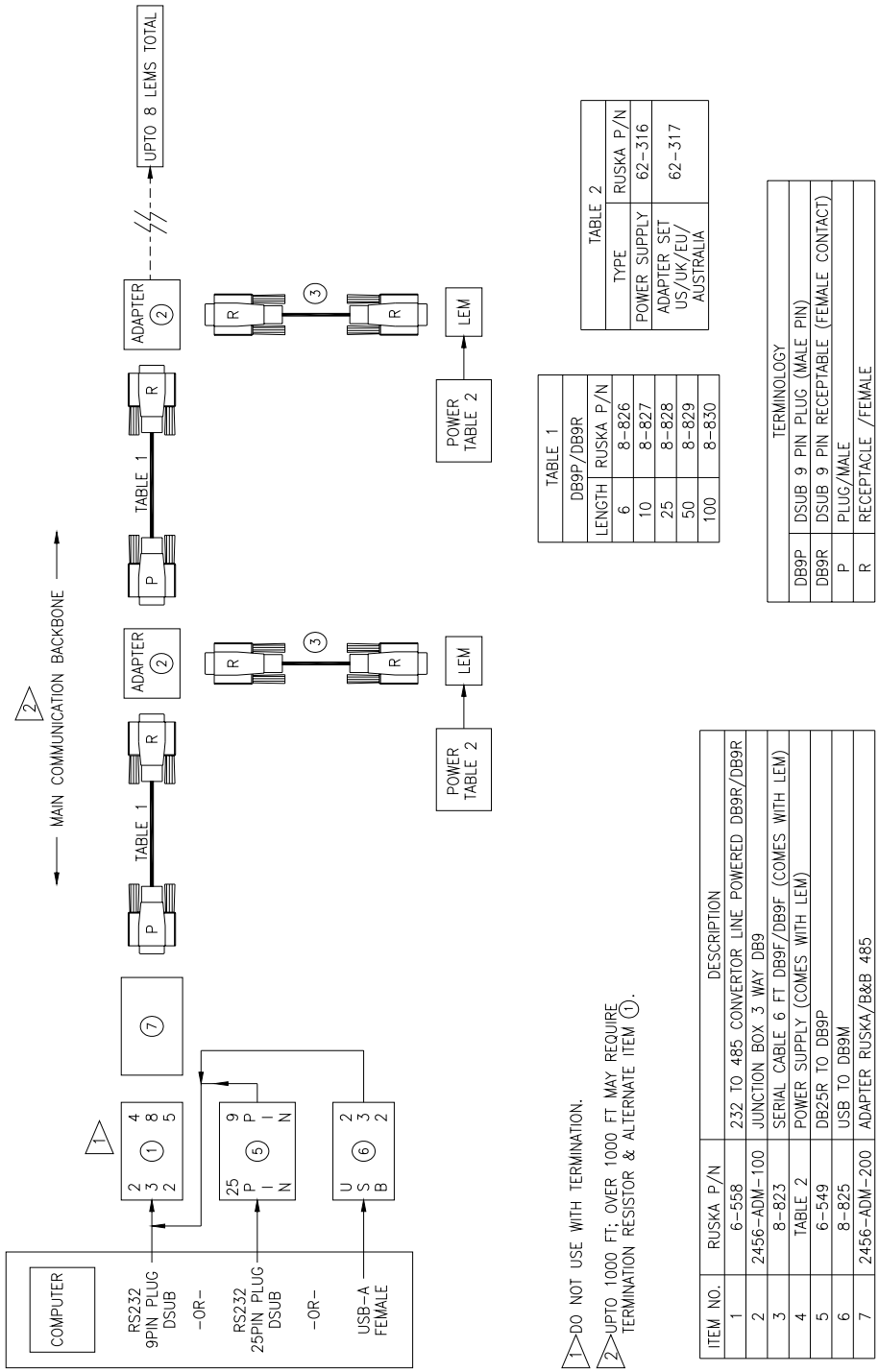
Command <Size>: 4
Reply <Size>: 6
<channel> is an 8-bit value.
<channel> selects channel to be calibrated. P for pressure, H for humidity, T for temperature.
<value> is a 16-bit signed integer using scaled (*100) units matching select channel.
<status> is three unsigned 8-bit values. (See Command A)
<counts> is an unsigned 16-bit value.

9.3 PRESSURE CONVERSION FACTORS

TABLE 9-1
PRESSURE CONVERSION FACTORS

units	x (multiplier)	= units
mbar	0.01450377	psi
hpa	0.01450377	psi
kpa	0.1450377	psi
Kg/cm^2	14.223343	psi
mmHg @ 0°C	0.0193368	psi
cmHg @ 0°C	0.193368	psi
inHg @ 0°C	0.491154	psi

9.4 RS485 MULTI-DROP CONFIGURATION



ITEM NO.	RUSKA P/N	DESCRIPTION
1	6-558	232 TO 485 CONVERTOR LINE POWERED DB9R/DB9R
2	2456-ADM-100	JUNCTION BOX 3 WAY DB9
3	8-823	SERIAL CABLE 6 FT DB9F/DB9F (COMES WITH LEM)
4	TABLE 2	POWER SUPPLY (COMES WITH LEM)
5	6-549	DB25R TO DB9P
6	8-825	USB TO DB9M
7	2456-ADM-200	ADAPTER RUSKA/B&B 485

TABLE 1	
DB9P/DB9R	
LENGTH	RUSKA P/N
6	8-826
10	8-827
25	8-828
50	8-829
100	8-830

TABLE 2	
TYPE	RUSKA P/N
POWER SUPPLY	62-316
ADAPTER SET US/UK/EU/ AUSTRALIA	62-317

TERMINOLOGY	
DB9P	DSUB 9 PIN PLUG (MALE PIN)
DB9R	DSUB 9 PIN RECEPTABLE (FEMALE CONTACT)
P	PLUG/MALE
R	RECEPTACLE /FEMALE